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(54) IMAGE SENSOR

(57)Abstract:
PROBLEM TO BE SOLVED: To provide an image sensor which can improve light

sensitivity by suppressing or preventing blooming effect.

SOLUTION: The image sensor has multiple unit pixels. Each unit pixel has a photo-sensing means 210 sensing incident light and generating photo-electric charge, a transmission means 220 transmitting the photo-electric charge to a sensing node, a first resetting means 230A resetting the sensing node by generating a complete depletion area in the photo-sensing means and supplying power voltage to the sensing node and a second resetting means 230B transmitting overcharge generating in the photo-sensing means to a power line when the sensing node is reset.

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CLAIMS

[Claim(s)]

[Claim 1] In the image sensors which have many unit pixels each unit pixel By making a perfect depletion region generate and supplying supply voltage at said sensing node in an optical sensing means to sense incident light and to generate a photoelectrical load, a transmission means to transmit said photoelectrical load to a sensing node, and said optical sensing means Image sensors characterized by having the 1st resetting means which makes said sensing node reset, and the 2nd resetting means which transmits the superfluous charge generated by said optical sensing means when said sensing node was reset to power-source Rhine.

[Claim 2] Image sensors according to claim 1 characterized by having amplified the voltage level of said sensing node and having further a magnification means

to generate the amplified signal, and a switching means to carry out switching operation and to output said amplified signal to an outgoing end.

[Claim 3] Said transmission means are image sensors according to claim 1 characterized by being connected between said optical sensing means and said sensing nodes.

[Claim 4] Said 1st resetting means is image sensors according to claim 3 characterized by being connected between said sensing nodes and said power-source Rhine.

[Claim 5] Said 2nd resetting means is image sensors according to claim 4 characterized by being connected between said optical sensing means and said power-source Rhine.

[Claim 6] Said optical sensing means are image sensors according to claim 5 characterized by being a photodiode.

[Claim 7] Said means of communication is image sensors according to claim 6 characterized by being a nMOS transistor.

[Claim 8] Said 1st and 2nd resetting means are image sensors according to claim 7 characterized by being a nMOS transistor.

[Claim 9] Image sensors according to claim 8 with which threshold voltage of

said 2nd resetting means is characterized by being lower than the threshold voltage of said 1st resetting means.

[Claim 10] Said photodiodes are image sensors according to claim 9 characterized by having the 1st doping field of the 2nd conduction type formed on the semi-conductor substrate of the 1st conduction type, and the semi-conductor substrate of said 1st conduction type, and the 2nd doping field of the 1st conduction type formed on this 1st doping field.

[Claim 11] Image sensors according to claim 10 with which the channel field of said 2nd doping field is characterized by connecting with the 1st doping field directly.

[Claim 12] Image sensors according to claim 11 with which said 2nd doping field is characterized by being in contact with said semi-conductor substrate.

[Claim 13] Image sensors according to claim 12 characterized by for said 1st conduction type being a p mold, and said 2nd conduction type being an n mold.

[Claim 14] Said semi-conductor substrates are image sensors according to claim 10 characterized by having further the epitaxial layer which is formed on said semi-conductor substrate and has high impurity concentration lower than the high impurity concentration of a semi-conductor substrate.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[The technical field to which invention belongs] Especially this invention relates

to the image sensors which have the unit pixel of a large number which can prevent the blooming effectiveness about image sensors.

[0002]

[Description of the Prior Art] As everyone knows, image sensors are equipment which senses the light reflected from a body and generates an image data. The image sensors especially manufactured using the CMOS (complementary metal oxide semiconductor) technique are called CMOS image sensors.

[0003] Generally, CMOS image sensors contain many unit pixels, and each unit pixel consists of one optical sensing element and many transistors. An optical sensing element like a photodiode senses the incident light reflected from a body, and accumulates a photoelectrical load, and a transistor controls transmission of the accumulated photoelectrical load.

[0004] Drawing 1 A is the circuit diagram showing the conventional unit pixel contained in CMOS image sensors. Here, a sign 160 is a load transistor which carries out the role which stabilizes the output signal of a unit pixel. Drawing 1 B is a drawing in which the layout over the conventional unit pixel shown in drawing 1 A is shown.

[0005] As illustrated, the conventional unit pixel consists of one photodiode 110

and four nMOS transistors. Four nMOS transistors are equipped with the function of the transfer transistor 120, the reset transistor 130, the magnification transistor 140, and a switching transistor 150, respectively.

[0006] A photodiode 110 senses incident light and generates a photoelectrical load. The transfer transistor 120 is connected with the sensing node Ns, answers the transfer control signal TX and transmits a photoelectrical load to the sensing node Ns.

[0007] The reset transistor 130 is connected with the sensing node Ns, answers a reset control signal, makes a perfect depletion region form in a photodiode 110, and supplies a reset electrical potential difference to a sensing node. The magnification transistor 140 generates the signal (DX) amplified by amplifying the voltage level of the sensing node Ns. The switching transistor 150 is connected with the magnification transistor 140 and the outgoing end Nout, and outputs the signal amplified through the outgoing end Nout as an image data by answering the switching control signal SX and carrying out switching operation.

[0008] In order to raise a charge transmission efficiency and to decrease electrical-potential-difference loss or the voltage drop of an image data in four nMOS transistors, the transfer transistor 120 and the reset transistor 130 are

embodied with the negative nMOS transistor which has a depletion mode (depletion mode) nMOS transistor or low threshold voltage.

[0009] Since the process in which the sensing node Ns is made to reset by this unit pixel is performed by the transfer transistor 120 and the reset transistor 130, the path of a superfluous charge should be formed in power-source Rhine VDD from the transfer transistor 120 and the reset transistor 130 in the saturation region. Therefore, the control to the electrical-potential-difference obstruction of the transfer transistor 120 and the reset transistor 130 is very important. If at least one of the transfer transistor 120 and the reset transistors 130 is not controlled correctly, a superfluous charge becomes flowing to the unit pixel which adjoined, and will induce malfunction. This phenomenon is called blooming effectiveness (blooming effect).

[0010] According to the blooming effectiveness, it becomes difficult to gain an exact image data, and there is a trouble of reducing the photosensitivity of CMOS image sensors.

[0011]

[Problem(s) to be Solved by the Invention] This invention has the purpose in offering the image sensors which can increase photosensitivity by being thought

out in order to solve the trouble mentioned above, and controlling or preventing the blooming effectiveness.

[0012]

[Means for Solving the Problem] In order to attain said purpose, the image sensors of this invention An optical sensing means to have many unit pixels, and for each unit pixel to sense incident light, and to generate a photoelectrical load, A transmission means to transmit said photoelectrical load to a sensing node, and the 1st resetting means which makes this sensing node reset by making a perfect depletion region generate and supplying supply voltage in said optical sensing means at said sensing node, When said sensing node is reset, it is characterized by having the 2nd resetting means which transmits the superfluous charge generated by said optical sensing means to power-source Rhine.

[0013]

[Embodiment of the Invention] In order that those who have the usual knowledge in the technical field which belongs may explain this invention to extent which can carry out this invention easily hereafter at a detail, the gestalt of desirable operation of this invention is explained with reference to the attached drawing.

[0014] Drawing 2 A is the circuit diagram showing the unit pixel contained in the CMOS image sensors concerning this invention. A sign 260 shows the load transistor used in order to stabilize the output signal of a unit pixel. Drawing 2 B is a drawing in which the layout of the unit pixel illustrated to drawing 2 A is shown.

[0015] If drawing 2 A is referred to, the unit pixel concerning this invention will consist of one photodiode 210 and five nMOS transistors as a control means as an optical sensing element. Five nMOS transistors are the transfer transistor 220, 1st reset transistor 230A, 2nd reset transistor 230B, the magnification transistor 240, and a switching transistor 250.

[0016] A photodiode 210 senses incident light and generates a photoelectrical load. The transfer transistor 220 is connected between a photodiode 210 and the sensing node Ns, answers the transfer control signal TX, and transmits a photoelectrical load to the sensing node Ns.

[0017] 1st reset transistor 230A carries out a reset action by being connected between the sensing node Ns and power-source Rhine VDD, answering the reset control signal RX, making a perfect depletion region form in a photodiode 210, and supplying a reset electrical potential difference to the sensing node Ns.

[0018] 2nd reset transistor 230B is connected between a photodiode 210 and power-source Rhine VDD, and transmits the superfluous charge generated with the photodiode 210 to power-source Rhine VDD. In this case, a superfluous charge is made to be transmitted to power-source Rhine VDD by forming lower than the threshold voltage of 1st reset transistor 230A the threshold voltage of 2nd reset transistor 230B easily.

[0019] The magnification transistor 240 generates the signal (DX) amplified by amplifying the voltage level of the sensing node Ns. A switching transistor 250 is connected between the magnification transistor 240 and an outgoing end Nout, and outputs the signal amplified through the outgoing end Nout by the image data by answering the switching control signal SX and carrying out switching operation.

[0020] As illustrated to drawing 2 B, it connects with the conductive layer with same gate G1 of 1st reset transistor 230A and gate G2 of 2nd reset transistor 230B.

[0021] Drawing 3 A and drawing 3 B are the sectional views cut by the A'-A line shown in drawing 2 B, and the A"-A line, respectively. If drawing 3 A and drawing 3 B are referred to, the photodiode 210 concerning this invention will be offered

by forming n mold doping field 302 and p mold doping field 303 in order on the semi-conductor substrate 301. Moreover, the channel field of 2nd reset transistor 230B is directly connected with n mold doping field 302 of a photodiode 210 like the transfer transistor 220.

[0022] As for the semi-conductor substrate 301, it is desirable to be provided by forming p mold epitaxial layer on p mold substrate. In this case, high impurity concentration of p mold epitaxial layer is made lower than the high impurity concentration of p mold substrate. Moreover, a perfect depletion region can be formed in a photodiode also with the supply voltage of 5V or 3.3 thru/or 2.5V by forming so that p mold doping field 303 may contact the semi-conductor substrate 301 directly.

[0023] Drawing 4 is a drawing in which the potential of the unit pixel after a reset action is shown. Since the threshold voltage of 2nd reset transistor 230B is lower than the threshold voltage of 1st reset transistor 230A, the superfluous charge 401 is easily transmitted to power-source Rhine VDD, and can prevent the blooming effectiveness, and the photosensitivity of CMOS image sensors improves, so that a drawing may show.

[0024] the technical thought of this invention -- the above -- although the

desirable example described, it is clear in this contractor for various modification, additions, and permutations to be possible within the limits of this invention limited by the claim.

[0025]

[Effect of the Invention] Migration to the contiguity unit pixel of the superfluous charge by which one reset transistor is added to the conventional unit pixel structure, and the photodiode was easily formed into perfect depletion, and the image sensors of this invention were generated with the photodiode is controlled. Therefore, improvement in photosensitivity can be aimed at.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1 A] It is the circuit diagram showing the conventional unit pixel contained in CMOS image sensors.

[Drawing 1 B] It is the drawing in which the layout of the unit pixel shown in drawing 1 A is shown.

[Drawing 2 A] It is the circuit diagram showing the unit pixel contained in the CMOS image sensors concerning this invention.

[Drawing 2 B] It is the drawing in which the layout of the unit pixel shown in drawing 2 A is shown.

[Drawing 3 A] It is an A'-A line sectional view in drawing 2 B.

[Drawing 3 B] It is an A"-A line sectional view in drawing 2 B.

[Drawing 4] It is the drawing in a reset action in which the potential of a unit pixel

is shown.

[Description of Notations]

210 Photodiode

220 Transfer Transistor

230A The 1st reset transistor

230B The 2nd reset transistor

240 Magnification Transistor

250 Switching Transistor

302 N Mold Doping Field

303 P Mold Doping Field